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EFFECTS OF MICROWAVE IRRADIATION

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DEVELOPMENT AND CLINICAL COURSE OF CARDIOVASCULAR CHANGES AFTER CHRONIC EXPOSURE TO MICROWAVE IRRADIATION

/Article by K. V. Glotova and M.N. Sadchikova, Institute of Labor Hygiene and Occupational Diseases, USSR Academy of Medical Sciences; Moscow, Gigiyena Truda Professional'nyye Zabolevaniya, Russian, No 7, 1970, submitted 13 June 1969, signed to press 5 June 1970, pp 24-27/

The results of experimental studies and clinical observations on the effect of low-intensity microwave irradiation in the one-centimeter range testify to the importance of neurologic changes, especially in the autonomic nervous system, along with hypotension and bradycardia (A. A. Kevork'yan; Z. V. Gordon; A. A. Orlova; others). Reports have also been published on the possible development of hypertensive and angiospastic reactions (N. V. Uspenskaya; E. A. Drogichina et al.; A. M. Monayenkova and M. N. Sadchikova; P. N. Fofanov).

Our purpose is to describe the nature, severity, and clinical course of the cardiovascular changes that follow chronic exposure to microwave irradiation. This information was derived from long-term clinical observations on 130 patients. The data pertain to 105 (90 males and 15 females) patients. Those with chronic tonsillitis, organic neurologic lesions, and cranial trauma were excluded.

Males under 40 constituted 78% of those examined. They were exposed in the course of their work, especially during the early years, to fairly intense microwaves in the one-centimeter range (several milliwatts per cm^2). Almost all had been on the job more than 5 years. The patients were divided into two groups according to the cardio-vascular changes. The first embraced 36 persons with asthenia; the second embraced 69 persons with the syndrome of autonomic-vascular dysfunction, including 25 with symptoms of hypothalamic insufficiency. The age and length of experience of both groups were the same. Almost all the patients in group 1 presented complaints of headache, ready fatigability, and insomnia. Many of them (34%) experienced

pains in the heart region, mostly of the fulgurant type without irradiation. Physical examination of the cardiovascular system revealed a fairly large number of persons with arterial hypotension (systolic arterial pressure up to 100 mm in 47%, 95 mm or below in more than one-half). Tachoscillography and polysphygmography (A. M. Monayenkova's data) showed a slight decrease in the average dynamic and lateral arterial pressure in some group 1 patients. Sinus bradycardia (EKG data) was recorded in 22%. Clinical and EKG examination of the heart failed to disclose any pacholoxical changes, despite the considerable length of time the patients had worked.

Increasing signs of asthenia were noted in the group 2 patients. All presented complaints of ready fatigability, especially when doing work involving tension or requiring attention and memory, irritability, headaches, often with nausea, vertigo, and noise in the autonomic reactions were unstable. Some 36% experienced autonomic-vascular crises: severe headaches, chills, tremor, syncope or brief unconsciousness, pallor or reddening of the face, constricting pain in the heart, sensation of labored breathing followed by great weakness. During a crisis arterial pressure rose in almost all the patients, sometimes accompanied by mild symptoms of bronchospasm, hives, and Quincke's edema. The temperature was periodically below normal (37.1 to 37.2°) in many patients at non-crisis times. Those with autonomic-vascular dysfunction complained mainly of pain in the heart, often constricting, with irradiation to the shoulder blade and arm. As a rule, the pain in the heart occurred against a neurotic background. It was persistent, intensifying during crises, and not responsive to vasoconstrictors, although the latter brought temporary relief.

Bradycardia was much less common in the group 2 patients, an indication of pulse lability. Tachycardia was noted in 36% of the group 2 patients; it was persistent in 20% of the cases. Some 68% of those with autonomic-vascular dysfunction had hypertensive reactions with elevated systolic and diastolic pressures to 160 to 180/100 mm, which developed in most cases against a background of normal arterial pressure and was often associated with constriction of the retinal arteries (S. F. Belovaya's studies).

Mechanocardiographic examination revealed a tendency for the average dynamic arterial pressure and lateral arterial pressure to increase (to 112 and 150 mm, respectively). Since the rate of propagation of pulse waves along blood vessels of the muscular type generally increased in these patients with increase in the ratios of the modulus of elasticity of blood vessels of the muscular and elastic types (2.0 to 2.3), the increase in elasticity of the latter vessels was probably caused by angiospasm. The minute volume in most patients with high arterial pressure decreased (to 30% of the expected value). It was regarded as an adequate reaction to the increase in peripheral resistance which exceeded the expected values and in some cases the active resistance as well.

Five patients with pronounced autonomic-vascular crises had a higher minute volume than expected (40 to 50%) together with an increase in all types of arterial pressure and high indices of specific peripheral

resistance. This was indicative, in our opinion, of marked disruption of the mechanisms regulating the correlation of peripheral and central hemodynamics. Examination of the heart showed a slight widening of the margins to the left in some of the patients with autonomic-vascular dysfunction, dullness of the heart tones in almost half, and a functional systolic murmur in a few. In 32% of the patients, mostly with hypertensive reactions, the EKG revealed a decrease, flattening, or inversion of the T wave, frequently in two standard (I-II or II-III) or left thoracic leads (V_{4-6}), and downward displacement of the S-T interval. The EKG changes usually occurred during crises and were accompanied by constricting pain in the heart. In most patients it was transient, disappearing after arterial pressure returned to normal. Chronic coronary insufficiency developed in 8.6% of the young patients, 2 of whom had suffered a myocardial infarct; in 3, crises were accompanied by the appearance of an extrasystole and in 1 by auricular fibrillation.

Of particular interest from the standpoint of the development and course of the cardiovascular pathology discussed above are the results of dynamic observations on a group of workers who had been exposed to microwaves in the one-centimeter range over a long period of time. The patients were divided into 3 groups according to the level of arterial pressure recorded during the first examination (cf. table). Group 1 consisted of 17 patients with arterial hypotension (systolic pressure 90 to 100 mm); group 2, 17 patients with normal arterial pressure (105 to 135 mm); group 3, 9 patients with a tendency to high arterial pressure, mainly systolic (140 to 145 mm or more). The average age and work experience was approximately the same in all 3 groups. Most of those in group 1 were healthy at the first examination. Three to 6 years later they developed asthenia and in some cases mild autonomic-vascular dysfunction with hypertensive reactions. None exhibited any persistent cardiovascular pathology. Five persons in group 1 were followed up for 9 to 12 years longer (all continued to work under the same conditions). Four of them developed hypertension, but none showed signs of hypothalamic insufficiency or marked myocardial pathology.

RESULTS OF DYNAMIC OBSERVATION

Group examined		1	2	3	First examination	3-6 years later
Examination periods						
Total examined		17	17	17	17	9
Average age in years		31	-	32	- 32	-
Average length of work experience		6,6	-	6	- 8	-
Healthy		5	1	5	- -	-
Asthenia		9	10	7	3 3	-
Autonomic-vascular dysfunction		3	6	5	14 6	9
Hypothalamic insufficiency		-	-	-	7 1	6
Bradycardia		4	-	4	1 2	1
Tachycardia		2	7	2	7 2	5
Arterial pressure (in mm)	90-95	8	3	-	- -	-
	100	9	6	-	- -	-
	140-145	-	3	-	6 8	1
	150-160	-	3	-	6 1	8
Hypertension		-	-	-	2 -	1
Change in T wave on the EKG	Slight decrease	-	-	-	7 1	4
	Marked decrease or inversion	-	-	-	4 -	3
Myocardial infarct		-	-	-	1 -	-
Dynamic disturbance of cerebral circulation		-	-	-	1 -	1
Constriction of retinal arteries		-	5	1	3 1	-
Retinal angiopathy		-	-	1	8 2	6

At the first examination of the workers in groups 2 and 3, only 5 of 26 were considered healthy and autonomic-vascular dysfunction was diagnosed in 11. After 3 to 6 years 16 of 26 patients in groups 1 and 2 exhibited symptoms of hypothalamic insufficiency against a background of pronounced hypertensive reactions with elevated and diastolic arterial pressure to 105 to 110 mm. Seven had chronic coronary insufficiency and 3 had hypertension. Eleven patients were classified as having class 3 disability, 4 as having class 2 disability. All 26 stopped working with radiowaves and were kept under observation for 2 to 3 years longer. Subjective improvement was reported during this time. Arterial pressure return to normal in 7, the EKG indices in 5. Of 4 patients with class 2 disability, 3 were rehabilitated. In only 1 person who ceased working with radiowaves 1½ years previously did the pathological symptoms progress. He remained disabled owing to dynamic impairment of the cerebral and coronary circulation.

Thus, long-term observations showed that the nature and intensity of the cardiovascular reactions to prolonged exposure to microwaves are closely related to neurologic changes, especially those in the autonomic nervous system. They also vary with the individual. Some exhibit for a long time only mild asthenic symptoms with sinus bradycardia and arterial hypotension with no signs of general or regional hemodynamic disturbances. Other develop autonomic-vascular dysfunction, often with symptoms of hypothalamic insufficiency and angiospasm which sometimes impair the cerebral and coronal circulation.

BILBIOGRAPHY

1. Gordon, Z. V., Gig. truda (Industrial Hygiene), 1958, No 6, p 1.
2. Gordon, Z. V., Trudy In-ta gigiyeny truda i profzabolevaniy AMN SSSR
3. (Transactions of the Institute of. Industrial Hygiene and Occupational Diseases, USSR Academy of Medical Sciences), 1960, No 1, p 65.
3. Gordon, Z. V., ibid., No 2, p 57.
4. Drogichina, E. A. N. M., Konchalovskaya, K. V. Glotova, et al., Gig. truda, 1966, No 7, p 13.
5. Kevork'yan, A. A., Gig. i san. (Hygiene and Sanitation), 1948, No 4, p 26.
6. Orlova, A. A., Trudy In-ta gigiyeny truda i Prof. zabolevaniy AMN SSSR, 1960, No 1, p 36.
7. Uspenskaya, N. V., Vrach. delo (Medical Affairs), 1961, No 3, p 124.
8. Fosfanov, P. N., Kardiologiya (Cardiology), 1969, No 4, p 124.

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CHANGE IN THYROID FUNCTION AFTER CHRONIC EXPOSURE TO MICROWAVE IRRADIATION

/Article by N. A. D'yachenko; Moscow, Gigiyena Truda i Professional'nyye Zabolevaniya, Russian, No 7, 1970, submitted 29 September 1969, signed to press 5 June 1970, pp 51-52/

Among the disorders resulting from prolonged exposure to microwaves are functional changes in the endocrine system, especially in the thyroid gland (Ye. V. Gembitskiy; E. A. Drogichina et al.; M. N. Sadchikova et al.). Therefore, it is of definite interest to elucidate the mechanism responsible for changes in thyroid function following prolonged exposure to microwaves and the nature of the resulting disturbances.

This report sets forth the data obtained in a study of thyroid function using I^{131} in persons systematically exposed to microwaves in the one-centimeter range over a long period of time. A total of 38 males 24 to 39 years of age who for 3 to 15 years had handled apparatus generating and emiting ultrahigh frequencies were examined in a hospital. The magnetic field strength of the ultrahigh-frequency fields at the work places during a shift exceeded the maximum permissible level. The duration of exposure during the work day was 3½ hours.

Each subject ingested on an empty stomach 2 microcuries of I^{131} mixed in a test tube with 2 ml of distilled water. Using a B type unit, the amount of absorbed I^{131} was determined 2, 4, and 24 hours after administration from the intensity of gamma radiation near the isthmus. Increased or decreased thyroid function was evaluated by comparing the results with the findings of some other investigators. According to M. N. Fateyeva and B. F. Korovkin, the normal incorporation of I^{131} into the thyroid of healthy persons 24 hours after administration is 15 to 33% of the dose ingested. V. P. Tkachev et al. also noted 15 to 25% incorporation of the isotope within 24 hours of administration. The normal daily absorption of I^{131} by the thyroid, according to Ye. V. Gembitskiy and N. V. Tyagin, is 15 to 30%. In analyzing the results, we took into account the rate of incorporation of I^{131} into the gland. Basal metabolism was also determined in all the subjects. Fluctuations within ±15% were considered normal.

The studies showed that the daily absorption of I^{131} by the thyroid was normal in 31, somewhat high in 7 person. Incorporation of the isotope 4 hours after administration exceeded 15% in 15. During the first 2 hours absorption accelerated in 18. According to V. N. Rusanov, and M. N. Fateyeva et al., with normal functioning of the thyroid, the rate of absorption after 2 hours normally does not exceed 8 to 10%.

None of the subjects exhibited symptoms of thyrotoxicosis. Basal metabolism ranged from -8 to +15%, i.e., it was within normal physiologic limits. It averaged only 9% above the expected value. A comprehensive clinical examination revealed the presence of the asthenic-neurotic syndrome with symptoms of autonomic-vascular dystonia in 18 persons. An increase in the daily amount and rate of absorption of I^{131} was mostly characteristic of persons with the asthenic syndrome and neurocirculatory dystonia of the hypertonic type. The amount of I^{131} incorporated into the thyroid of patients with neurocirculatory dystonia was statistically significantly higher than in healthy persons. These findings are consistent with the results of the studies of V. N. Rusanov who observed an increase in thyroid function in patients with neurocirculatory dystonia of the hypertonic type.

Our data thrown some light on the pathogenesis of the functional disturbances of the thyroid in individuals exposed to microwaves over a long period of time. Numerous studies (Ye. V. Gembitskiy; E. A. Drogichina; Ye. V. Yermakov; others) showed that microwaves in acting on organs and tissues impairs the correlations of the main nervous processes and diencephalic regulation. This is clinically manifested by different kinds of asthenia and autonomic-vascular dystonia. The endocrine system is known to be constantly controlled by the higher autonomic divisions of the central nervous system situated in the hypothalamic region. The functional changes in the central nervous system caused by microwave irradiation naturally affect the function of the endocrine glands. This seems to explain why thyroid activity increased in those with the asthenic-autonomic syndrom and neurocirculatory dystonia. Consequently, impairment of thyroid function was secondary and apparently one of the manifestations of the general adaptive reactions. Confirmation of this comes from the studies of I. R. Petrov and V. A. Pukhov who observed in animals exposed to microwaves an intensification of adrenocorticotropic function in the anterior lobe of the hypophysis and an elevated level of blood glucocorticoid hormones secreted by the adrenal cortex. The nature of the changes and resistance to microwave irradiation were largely dependent on the typological peculiarities of the animals' nervous activity and functional state of their central nervous system. Inadequate internal inhibition or artificially induced excitation of the nervous system increased the animals' sensitivity to ultrahigh-frequency irradiation. Many investigators believe this is related to insufficiency of the adaptive reactions.

BIBLIOGRAPHY

1. Drogichina, E. A., in the book: O biologicheskom vozdeystvii sverkhysokikh chastot (Biological Effects of Ultrahigh Frequencies). Moscow, 1960, p 23.
2. Drogichina, E. A. et al., Gig. truda (Industrial Hygiene), 1962, No 2, p 28.
3. Yermakov, Ye. V., Voyen.-med. zh. (Journal of Military Medicine), 1969, No 3, p 42.
4. Korovkin, B. F. and S. V. Malukov, in the book: Sbornik nauchnykh trudov Leningradsk, okruzhnogo voyennogo gospitalya (Collection of Scientific Works of the Leningrad District Military Hospital), Leningrad, 1958, p 346.
5. Sadchikova, M. N. and M. I. Smirnova, in the book: O biologicheskom vozdeystvii sverkhvysokikh chastot, Moscow, 1960, p 50.
6. Tkachev, V. P. and Ye. V. Utekhin, in the book: Voprosy gipertonicheskoy bolezni u molodykh lyudey (Hypertension in Young People). Leningrad, 1959, p 67.
7. Fateyeva, M. N., in the book: Trudy po primeniyu radioaktivnykh izotopov v meditsine (Studies on the Use of Radioactive Isotopes in Medicine). Moscow, 1953, p 122.

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